Solvay Business School

Université Libre de Bruxelles
Faculté SOCO
2008-2009

ULB

ADV. FINANCE
GEST-D-410
Prof. H. Pirotte

LASTNAME :

FIRSTNAME :

STUDENT Id :

Final Exam

Form A

Monday 24 August 2009

Indications

Please follow these indications:

1. The exam lasts 3 hours.
2. Please verify that your document contains exactly 9 pages.
3. There are 20 questions plus 2 bonus questions.
4. Each question is worth one point.
5. Please write your first name and last name on the first page.
6. Good work!!!

Problems

P1 Asset pricing

Ramon Sanchez is the trader of derivative securities in a strange environment: all products are bought one day and sold the next, so there is only one period in all investments. Moreover, assets can only take two values at the end of that period.
First of all, there is a risk-free asset. For 1'000 EUR invested at time 0, you can get 1'050 EUR at time 1, for both outcomes.
At the same time, there is a macro risky asset being traded at 1'200 EUR. At time 1, you can get either 2'000 (good economy case) or 720 in the bad economy case. Statistically, both cases can happen equiprobably.

Q1 What is the risk-neutral probability priced by the market?

Q2 What is the required rate of return of the market for the macro risky asset?

Q3 Imagine that you want to create a new asset that insures anyone against a loss on the macro risky asset. Relying on the current value of 1'200 EUR and on the various outcomes presented here above, how much should be the value of that insurance?

Q4 What hypothesis/assumptions do need to be verified for the price computed in the previous question to be sustainable?

Q5 If you would have the following choice to value the firm, which one would you choose and why? Base you answer on the fundamental differences between these methodologies.

a) An asset pricing model as presented here above with foreseen outcomes and corresponding probabilities implied from the economy.
b) Multiples (also called comparable ratios) to other firms like the P/E ratio, the Price-to-Sales ratio

Q6 From this simple 1-period/2 outcomes asset pricing model, how could you modify it to assess real problems with many more potential outcomes in the future?

P2 Cost of capital

We are in 2008, Matt, a good friend of you wants to sell the company he set up at the end of his studies at the SBS-EM. Knowing that your scores in the finance courses were always better than his, he asks you to help him find a value for its company and give you the following data:

CF statement (thousands EUR)	2009	2010	2011
Debt (Market value)	250	300	350
EBITDA	100	150	200
Depreciation	50	100	100
Δ WCR	0	0	0
Investment CF	-400	0	0

Cost of capital data	
Interest on Debt	9%
Tax rate	40%
Ka	12%
Kd	9%

For the years 2012→ ∞, the only thing he is able to tell you is that the growth rate of the unlevered free cash flows is 4%. To find the total value of the company in 2008, he asks you to take things step by step:

Q7 First, he tried to use the MM, ME and HP WACC to compute the value of the company for the period going from 2009 to 2011, but no one seems to give consistent results, can you explain why and propose a solution?

Q8 Secondly, compute the value in 2008 based on the first three years (2009 – 2011) with the method you advocate in the previous question.

Q9 Thirdly, compute the value of the company for the remaining years (2012→ ∞), knowing that from 2012 onwards the value of the debt will be equal to 10% of the total value of the company (rebalanced each year).

Q10 Compute the total value of the company. If you don't have a result for the previous question, please use a company value of 0 for the first three years and a value of 2'500'000 (in 2011) for the present value of cash-flows going from 2012 → ∞.

Q11 You just finished your computations for the value of the company and your friend come to you very sorry, telling you that he forgot to mention that buying this company will allow the buyer to launch another product line over the next 3 years (2010) which cost is estimated to be 100'000 EUR, and which estimated cash flows are 70'000 EUR (2008). If the new product estimated cash-flows have a variance of 0.05 and if the risk-free rate is 3.5%, compute the amount to add in the project valuation.

Q12 If the interest on debt is different from the cost of debt, how will your computations of the terminal value be affected?

Q13 If the unlevered free cash flows stream in the future is constant until infinity, do you think that is more correct to use the HP WACC or the MM WACC? Do you think that the amount of debt will be equal in the two cases?

P3 Binomial trees, risky debt and financing the corporation…

You have just been appointed CFO of Ford (the Motor Company). The economics crisis and years of bad management have put the firm into a very sensitive situation. To finance its WCR, Ford needs some fresh money, the bond market being very cold today, you decide to call on the federal government of the USA asking a federal loan of 300 mio EUR for 1 year (zero coupon loan with an interest of 5%). The government accepts to lend you this amount provided their debt will be reimbursed prior to every other debt. The market value of Ford's assets is 1000 mio EUR today, and the company's current debt is a zero coupon with face value of 800 mio EUR maturing in one year. The volatility of the assets of the company is 45%. The risk free rate is 3.5%.

Q14 Compute the relative distance to default of Ford (without the new debt).

Q15 Will the old debtholders accept the new loan (answer using a binomial tree)? Is the interest rate of the state's loan fair? Comment.

Q16 Based on your previous answer, compute the credit spread on the old debtholders debt and the expected loss given default of the two loans. If you don't have a result for the previous question, please use a value of 650 for the old debt.

Q17 Seeing the anger of the old debtholders, the state accepts to lend to Ford and to pay half of loss given default born by the old debtholders in case of default. Will the old debtholders agree now (answer using a binomial tree)?

Q18 If the state does not want to lend to Ford, the management has a rescue plan: invest massively in electrical cars, this project has a net present value of -50 but will increase the volatility of Ford asses to 60%. Will they launch the new project (answer using a binomial tree)?

Q19 (Bonus) Compute the value of the implicit CDS (and its delta) the state grants to the old shareholders.

P4 Capital structure (empirical study)

The following problem is based on the article : "Control Rights and Capital Structure: An Empirical Investigation", by MICHAEL R. ROBERTS, and AMIR SUFI, THE JOURNAL OF FINANCE • VOL. LXIV, NO. 4 • AUGUST 2009.

Table III

Covenant Violations and Net Debt Issuance

This table presents coefficient estimates of firm fixed effects regressions (Panel A) and first difference regressions (Panel B) of net debt issuance on covenant violation indicators and control variables. The specifications reported in columns (2)–(4) of Panel A include lagged natural logarithm of total assets, the lagged tangible assets to total assets ratio, the lagged market-to-book ratio, and a lagged "has S&P rating" indicator as control variables. In addition, the specification in column (2) of Panel A includes the 11 *covenant control variables*: the lagged book debt to assets ratio, the lagged net worth to assets ratio, the lagged cash to assets ratio, the lagged and current EBITDA to lagged assets ratio, the lagged and current cash flow to lagged assets ratio, the lagged and current net income to lagged assets ratio, and the lagged and current interest expense to lagged assets ratio. Column (3) of Panel A includes the covenant control variables in addition to four *covenant control interaction variables*: the lagged debt to assets ratio interacted with the lagged cash flow to lagged assets ratio, the lagged debt to assets ratio interacted with the lagged EBITDA to lagged assets ratio, the lagged debt to assets ratio interacted with the lagged net worth to assets ratio, and the lagged EBITDA to lagged assets ratio interacted with the lagged interest expense to lagged assets ratio. Column (4) of Panel A includes all covenant control variables and covenant control interaction variables, these variables squared and to the third power, and five quantile indicator variables for each of the controls. Columns (1)–(4) of Panel B include the first differenced analogs to control variables in Panel A, with the exception of measures using debt, which are differences lagged two quarters instead of one-quarter to avoid spurious correlations. All specifications include calendar year-quarter indicator variables and fiscal quarter indicator variables. Standard errors are reported in parentheses and are clustered by firm.

Panel A: Fixed Effects				
Dependent Variable: Net debt issuance$_t$/assets$_{t-1}$ (Basis Points)				
	(1)	(2)	(3)	(4)
Covenant violation$_t$	8.4	3.2	2.2	3.2
	(8.1)	(7.6)	(7.7)	(7.6)
Covenant violation$_{t-1}$	−62.2**	−50.3**	−54.3**	−50.3**
	(7.8)	(7.2)	(7.2)	(7.2)
Covenant control variables	None	Covenant control variables	Covenant control variables, covenant interaction control variables	Control variables, control variables squared, control variables to the third power, and quintile indicators for each control
Number of firm-quarters	135,736	135,736	135,736	135,736
Number of firms	6,381	6,381	6,381	6,381
R^2	0.051	0.183	0.187	0.204

Panel B: First Differences				
Dependent Variable: Change in Net debt issuance$_t$/assets$_{t-1}$ (Basis Points)				
	(1)	(2)	(3)	(4)
Covenant violation$_t$	9.2	−3.3	−2.3	2.2
	(11.0)	(10.1)	(10.1)	(10.0)
Covenant violation$_{t-1}$	−44.9**	−60.4**	−59.7**	−50.3**
	(11.2)	(10.3)	(10.3)	(10.3)
Covenant control variables	None	Covenant control variables	Covenant control variables, covenant interaction control variables	Control variables, control variables squared, control variables to the third power, and quintile indicators for each control
Number of firm-quarters	123,557	123,557	123,557	123,557
Number of firms	6,345	6,345	6,345	6,345
R^2	0.003	0.139	0.140	0.159

** Statistically distinct from zero at the 1% level.

Q20 Please comment the table linking the analysis presented in this paper with the theory on capital structure presented in class. Please make yourself self-explanatory.

P5 Readings

Q21 Harris & Raviv (1991) presents an impressive review of capital structure theories visited so far. By the end of the 20th century, what were the most important theories explaining the optimal level of debt? List them and briefly explain in 2-3 lines what we can learn from them.

Q22 **(Bonus)** Describe the approach brought by KMV, known as the KMV approach or model, to assess the creditworthiness of corporate firms (reading reference: Crosbie, P. and J. Bohn (2003), "Modeling Default Risk", *Moodys'|K.M.V.*, December 2003.)

Present the main insights, steps, and advantages of the approach.

N(x) & N(-x)=1-N(x) H. Pirotte - SBS/ULB - FinMetrics SA - Juin 2007

	0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050	0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.090	0.095
0.0	0.5000	0.5020	0.5040	0.5060	0.5080	0.5100	0.5120	0.5140	0.5160	0.5179	0.5199	0.5219	0.5239	0.5259	0.5279	0.5299	0.5319	0.5339	0.5359	0.5378
0.1	0.5398	0.5418	0.5438	0.5458	0.5478	0.5497	0.5517	0.5537	0.5557	0.5576	0.5596	0.5616	0.5636	0.5655	0.5675	0.5695	0.5714	0.5734	0.5753	0.5773
0.2	0.5793	0.5812	0.5832	0.5851	0.5871	0.5890	0.5910	0.5929	0.5948	0.5968	0.5987	0.6006	0.6026	0.6045	0.6064	0.6083	0.6103	0.6122	0.6141	0.6160
0.3	0.6179	0.6198	0.6217	0.6236	0.6255	0.6274	0.6293	0.6312	0.6331	0.6350	0.6368	0.6387	0.6406	0.6424	0.6443	0.6462	0.6480	0.6499	0.6517	0.6536
0.4	0.6554	0.6573	0.6591	0.6609	0.6628	0.6646	0.6664	0.6682	0.6700	0.6718	0.6736	0.6754	0.6772	0.6790	0.6808	0.6826	0.6844	0.6862	0.6879	0.6897
0.5	0.6915	0.6932	0.6950	0.6967	0.6985	0.7002	0.7019	0.7037	0.7054	0.7071	0.7088	0.7106	0.7123	0.7140	0.7157	0.7174	0.7190	0.7207	0.7224	0.7241
0.6	0.7257	0.7274	0.7291	0.7307	0.7324	0.7340	0.7357	0.7373	0.7389	0.7405	0.7422	0.7438	0.7454	0.7470	0.7486	0.7502	0.7517	0.7533	0.7549	0.7565
0.7	0.7580	0.7596	0.7611	0.7627	0.7642	0.7658	0.7673	0.7688	0.7704	0.7719	0.7734	0.7749	0.7764	0.7779	0.7794	0.7808	0.7823	0.7838	0.7852	0.7867
0.8	0.7881	0.7896	0.7910	0.7925	0.7939	0.7953	0.7967	0.7981	0.7995	0.8009	0.8023	0.8037	0.8051	0.8065	0.8078	0.8092	0.8106	0.8119	0.8133	0.8146
0.9	0.8159	0.8173	0.8186	0.8199	0.8212	0.8225	0.8238	0.8251	0.8264	0.8277	0.8289	0.8302	0.8315	0.8327	0.8340	0.8352	0.8365	0.8377	0.8389	0.8401
1.0	0.8413	0.8426	0.8438	0.8449	0.8461	0.8473	0.8485	0.8497	0.8508	0.8520	0.8531	0.8543	0.8554	0.8566	0.8577	0.8588	0.8599	0.8610	0.8621	0.8632
1.1	0.8643	0.8654	0.8665	0.8676	0.8686	0.8697	0.8708	0.8718	0.8729	0.8739	0.8749	0.8760	0.8770	0.8780	0.8790	0.8800	0.8810	0.8820	0.8830	0.8840
1.2	0.8849	0.8859	0.8869	0.8878	0.8888	0.8897	0.8907	0.8916	0.8925	0.8934	0.8944	0.8953	0.8962	0.8971	0.8980	0.8988	0.8997	0.9006	0.9015	0.9023
1.3	0.9032	0.9041	0.9049	0.9057	0.9066	0.9074	0.9082	0.9091	0.9099	0.9107	0.9115	0.9123	0.9131	0.9139	0.9147	0.9154	0.9162	0.9170	0.9177	0.9185
1.4	0.9192	0.9200	0.9207	0.9215	0.9222	0.9229	0.9236	0.9244	0.9251	0.9258	0.9265	0.9272	0.9279	0.9285	0.9292	0.9299	0.9306	0.9312	0.9319	0.9325
1.5	0.9332	0.9338	0.9345	0.9351	0.9357	0.9364	0.9370	0.9376	0.9382	0.9388	0.9394	0.9400	0.9406	0.9412	0.9418	0.9424	0.9429	0.9435	0.9441	0.9446
1.6	0.9452	0.9458	0.9463	0.9468	0.9474	0.9479	0.9484	0.9490	0.9495	0.9500	0.9505	0.9510	0.9515	0.9520	0.9525	0.9530	0.9535	0.9540	0.9545	0.9550
1.7	0.9554	0.9559	0.9564	0.9568	0.9573	0.9577	0.9582	0.9586	0.9591	0.9595	0.9599	0.9604	0.9608	0.9612	0.9616	0.9621	0.9625	0.9629	0.9633	0.9637
1.8	0.9641	0.9645	0.9649	0.9652	0.9656	0.9660	0.9664	0.9667	0.9671	0.9675	0.9678	0.9682	0.9686	0.9689	0.9693	0.9696	0.9699	0.9703	0.9706	0.9710
1.9	0.9713	0.9716	0.9719	0.9723	0.9726	0.9729	0.9732	0.9735	0.9738	0.9741	0.9744	0.9747	0.9750	0.9753	0.9756	0.9759	0.9761	0.9764	0.9767	0.9770
2.0	0.9772	0.9775	0.9778	0.9780	0.9783	0.9786	0.9788	0.9791	0.9793	0.9796	0.9798	0.9801	0.9803	0.9805	0.9808	0.9810	0.9812	0.9815	0.9817	0.9819
2.1	0.9821	0.9824	0.9826	0.9828	0.9830	0.9832	0.9834	0.9836	0.9838	0.9840	0.9842	0.9844	0.9846	0.9848	0.9850	0.9852	0.9854	0.9856	0.9857	0.9859
2.2	0.9861	0.9863	0.9864	0.9866	0.9868	0.9870	0.9871	0.9873	0.9875	0.9876	0.9878	0.9879	0.9881	0.9882	0.9884	0.9885	0.9887	0.9888	0.9890	0.9891
2.3	0.9893	0.9894	0.9896	0.9897	0.9898	0.9900	0.9901	0.9902	0.9904	0.9905	0.9906	0.9907	0.9909	0.9910	0.9911	0.9912	0.9913	0.9915	0.9916	0.9917
2.4	0.9918	0.9919	0.9920	0.9921	0.9922	0.9923	0.9925	0.9926	0.9927	0.9928	0.9929	0.9930	0.9931	0.9931	0.9932	0.9933	0.9934	0.9935	0.9936	0.9937
2.5	0.9938	0.9939	0.9940	0.9940	0.9941	0.9942	0.9943	0.9944	0.9945	0.9945	0.9946	0.9947	0.9948	0.9948	0.9949	0.9950	0.9951	0.9951	0.9952	0.9953
2.6	0.9953	0.9954	0.9955	0.9955	0.9956	0.9957	0.9957	0.9958	0.9959	0.9959	0.9960	0.9960	0.9961	0.9962	0.9962	0.9963	0.9963	0.9964	0.9964	0.9965
2.7	0.9965	0.9966	0.9966	0.9967	0.9967	0.9968	0.9968	0.9969	0.9969	0.9970	0.9970	0.9971	0.9971	0.9972	0.9972	0.9972	0.9973	0.9973	0.9974	0.9974
2.8	0.9974	0.9975	0.9975	0.9976	0.9976	0.9976	0.9977	0.9977	0.9977	0.9978	0.9978	0.9978	0.9979	0.9979	0.9979	0.9980	0.9980	0.9980	0.9981	0.9981
2.9	0.9981	0.9982	0.9982	0.9982	0.9982	0.9983	0.9983	0.9983	0.9984	0.9984	0.9984	0.9984	0.9985	0.9985	0.9985	0.9985	0.9986	0.9986	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9987	0.9987	0.9988	0.9988	0.9988	0.9988	0.9988	0.9989	0.9989	0.9989	0.9989	0.9989	0.9989	0.9990	0.9990	0.9990	0.9990
3.1	0.9990	0.9990	0.9991	0.9991	0.9991	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993	0.9993	0.9993	0.9993
3.2	0.9993	0.9993	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998	0.9998	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.7	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.8	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	1.0000
3.9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4.0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Call Prices with Black & Scholes Option Pricing

Price of a B&Sch call option where result=C/S

Cumulative Volatility:	Moneyness: S/K*exp(-rT)																							
Sigma*SQRT(T)	**0.40**	**0.45**	**0.50**	**0.55**	**0.60**	**0.65**	**0.70**	**0.75**	**0.80**	**0.85**	**0.90**	**0.95**	**1.00**	**1.05**	**1.10**	**1.15**	**1.20**	**1.25**	**1.30**	**1.35**	**1.40**	**1.45**	**1.50**	**1.55**
0.00	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.76%	9.09%	13.04%	16.67%	20.00%	23.08%	25.93%	28.57%	31.03%	33.33%	35.48%
0.05	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%	0.41%	1.99%	5.19%	9.14%	13.05%	16.67%	20.00%	23.08%	25.93%	28.57%	31.03%	33.33%	35.48%
0.10	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.05%	0.24%	0.79%	1.99%	3.99%	6.73%	9.96%	13.39%	16.79%	20.04%	23.09%	25.93%	28.57%	31.03%	33.33%	35.48%
0.15	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.05%	0.18%	0.50%	1.15%	2.25%	3.86%	5.98%	8.52%	11.36%	14.37%	17.41%	20.40%	23.29%	26.04%	28.63%	31.06%	33.35%	35.49%
0.20	0.00%	0.00%	0.00%	0.01%	0.04%	0.14%	0.35%	0.77%	1.48%	2.54%	3.99%	5.81%	7.97%	10.39%	12.99%	15.71%	18.46%	21.19%	23.85%	26.43%	28.89%	31.24%	33.46%	35.56%
0.25	0.00%	0.01%	0.03%	0.09%	0.24%	0.53%	1.03%	1.78%	2.83%	4.19%	5.86%	7.79%	9.95%	12.28%	14.72%	17.23%	19.75%	22.27%	24.73%	27.13%	29.44%	31.66%	33.78%	35.80%
0.30	0.01%	0.05%	0.15%	0.35%	0.70%	1.25%	2.04%	3.10%	4.42%	5.99%	7.79%	9.78%	11.92%	14.17%	16.49%	18.84%	21.20%	23.53%	25.83%	28.06%	30.23%	32.32%	34.32%	36.25%
0.35	0.08%	0.20%	0.44%	0.84%	1.44%	2.26%	3.33%	4.63%	6.15%	7.87%	9.76%	11.78%	13.89%	16.07%	18.29%	20.52%	22.73%	24.92%	27.07%	29.16%	31.20%	33.16%	35.06%	36.88%
0.40	0.23%	0.50%	0.94%	1.58%	2.43%	3.52%	4.82%	6.31%	7.99%	9.81%	11.75%	13.77%	15.85%	17.97%	20.10%	22.22%	24.32%	26.39%	28.42%	30.39%	32.30%	34.16%	35.95%	37.68%
0.45	0.54%	1.00%	1.67%	2.55%	3.66%	4.96%	6.45%	8.10%	9.89%	11.77%	13.74%	15.76%	17.80%	19.86%	21.91%	23.94%	25.95%	27.91%	29.83%	31.69%	33.51%	35.26%	36.96%	38.60%
0.50	1.01%	1.70%	2.61%	3.74%	5.06%	6.55%	8.20%	9.97%	11.83%	13.76%	15.73%	17.73%	19.74%	21.74%	23.72%	25.68%	27.59%	29.46%	31.29%	33.06%	34.78%	36.45%	38.06%	39.61%
0.55	1.68%	2.61%	3.75%	5.09%	6.61%	8.26%	10.03%	11.88%	13.80%	15.75%	17.72%	19.70%	21.67%	23.61%	25.53%	27.41%	29.25%	31.04%	32.78%	34.47%	36.11%	37.69%	39.23%	40.71%
0.60	2.53%	3.69%	5.06%	6.60%	8.27%	10.05%	11.91%	13.83%	15.78%	17.75%	19.71%	21.66%	23.58%	25.48%	27.33%	29.14%	30.91%	32.62%	34.29%	35.91%	37.47%	38.98%	40.44%	41.86%
0.65	3.55%	4.95%	6.51%	8.22%	10.03%	11.91%	13.84%	15.80%	17.77%	19.74%	21.68%	23.60%	25.48%	27.32%	29.12%	30.87%	32.57%	34.22%	35.82%	37.36%	38.86%	40.30%	41.70%	43.05%
0.70	4.74%	6.34%	8.08%	9.93%	11.85%	13.82%	15.80%	17.79%	19.77%	21.72%	23.64%	25.53%	27.37%	29.16%	30.90%	32.59%	34.23%	35.81%	37.35%	38.83%	40.26%	41.65%	42.98%	44.27%
0.75	6.07%	7.86%	9.76%	11.72%	13.73%	15.76%	17.78%	19.78%	21.76%	23.70%	25.59%	27.44%	29.23%	30.98%	32.67%	34.30%	35.88%	37.41%	38.88%	40.31%	41.68%	43.01%	44.29%	45.52%
0.80	7.52%	9.48%	11.51%	13.58%	15.65%	17.72%	19.77%	21.78%	23.74%	25.66%	27.52%	29.33%	31.08%	32.78%	34.42%	36.00%	37.52%	39.00%	40.42%	41.78%	43.11%	44.38%	45.61%	46.79%
0.85	9.08%	11.19%	13.33%	15.48%	17.61%	19.71%	21.76%	23.77%	25.72%	27.61%	29.44%	31.21%	32.92%	34.56%	36.15%	37.68%	39.16%	40.58%	41.94%	43.26%	44.53%	45.75%	46.93%	48.07%
0.90	10.74%	12.97%	15.20%	17.41%	19.58%	21.70%	23.76%	25.75%	27.68%	29.54%	31.34%	33.07%	34.73%	36.33%	37.87%	39.35%	40.77%	42.14%	43.46%	44.73%	45.95%	47.13%	48.26%	49.35%
0.95	12.47%	14.81%	17.12%	19.37%	21.57%	23.69%	25.75%	27.72%	29.63%	31.46%	33.21%	34.90%	36.52%	38.08%	39.57%	41.00%	42.38%	43.70%	44.97%	46.19%	47.37%	48.50%	49.59%	50.64%
1.00	14.27%	16.70%	19.06%	21.35%	23.56%	25.68%	27.73%	29.68%	31.56%	33.35%	35.07%	36.72%	38.29%	39.80%	41.25%	42.64%	43.97%	45.24%	46.47%	47.65%	48.78%	49.87%	50.92%	51.92%
1.05	16.13%	18.62%	21.03%	23.34%	25.55%	27.67%	29.69%	31.62%	33.47%	35.22%	36.90%	38.51%	40.04%	41.51%	42.91%	44.25%	45.54%	46.77%	47.96%	49.09%	50.18%	51.23%	52.24%	53.21%
1.10	18.03%	20.58%	23.01%	25.33%	27.54%	29.65%	31.65%	33.55%	35.35%	37.08%	38.72%	40.28%	41.77%	43.19%	44.55%	45.85%	47.09%	48.28%	49.43%	50.52%	51.57%	52.58%	53.55%	54.48%
1.15	19.96%	22.55%	25.00%	27.33%	29.53%	31.61%	33.58%	35.45%	37.22%	38.90%	40.50%	42.02%	43.47%	44.85%	46.17%	47.43%	48.63%	49.78%	50.88%	51.93%	52.95%	53.92%	54.85%	55.75%
1.20	21.92%	24.53%	27.00%	29.32%	31.50%	33.56%	35.50%	37.33%	39.06%	40.71%	42.26%	43.74%	45.15%	46.49%	47.76%	48.98%	50.14%	51.25%	52.31%	53.33%	54.31%	55.24%	56.14%	57.01%
1.25	23.89%	26.53%	28.99%	31.30%	33.46%	35.48%	37.39%	39.19%	40.88%	42.48%	44.00%	45.44%	46.80%	48.10%	49.33%	50.51%	51.63%	52.71%	53.73%	54.71%	55.65%	56.56%	57.42%	58.25%
1.30	25.88%	28.52%	30.98%	33.26%	35.40%	37.39%	39.26%	41.02%	42.68%	44.24%	45.71%	47.11%	48.43%	49.69%	50.88%	52.02%	53.10%	54.14%	55.13%	56.08%	56.98%	57.85%	58.69%	59.49%
1.35	27.87%	30.51%	32.95%	35.21%	37.31%	39.28%	41.11%	42.83%	44.44%	45.96%	47.39%	48.75%	50.03%	51.25%	52.41%	53.51%	54.55%	55.55%	56.51%	57.42%	58.29%	59.13%	59.93%	60.70%
1.40	29.87%	32.50%	34.91%	37.14%	39.21%	41.14%	42.93%	44.61%	46.18%	47.66%	49.05%	50.36%	51.61%	52.79%	53.90%	54.97%	55.98%	56.94%	57.86%	58.74%	59.58%	60.39%	61.16%	61.91%
1.45	31.86%	34.47%	36.86%	39.06%	41.09%	42.97%	44.72%	46.36%	47.89%	49.32%	50.68%	51.95%	53.15%	54.29%	55.38%	56.40%	57.38%	58.31%	59.20%	60.05%	60.86%	61.63%	62.38%	63.09%
1.50	33.84%	36.42%	38.78%	40.94%	42.93%	44.78%	46.49%	48.08%	49.57%	50.96%	52.27%	53.51%	54.67%	55.78%	56.82%	57.81%	58.76%	59.65%	60.51%	61.33%	62.11%	62.86%	63.57%	64.26%
1.55	35.81%	38.36%	40.68%	42.81%	44.75%	46.55%	48.22%	49.77%	51.22%	52.57%	53.84%	55.04%	56.17%	57.23%	58.24%	59.20%	60.11%	60.97%	61.80%	62.59%	63.34%	64.06%	64.75%	65.41%
1.60	37.76%	40.28%	42.56%	44.64%	46.55%	48.30%	49.92%	51.43%	52.84%	54.15%	55.38%	56.54%	57.63%	58.66%	59.63%	60.56%	61.43%	62.27%	63.06%	63.82%	64.55%	65.24%	65.90%	66.54%
1.65	39.69%	42.17%	44.41%	46.45%	48.31%	50.02%	51.60%	53.06%	54.42%	55.70%	56.89%	58.01%	59.06%	60.06%	61.00%	61.89%	62.74%	63.54%	64.31%	65.04%	65.73%	66.40%	67.04%	67.65%
1.70	41.61%	44.04%	46.24%	48.22%	50.04%	51.70%	53.24%	54.66%	55.98%	57.21%	58.37%	59.45%	60.47%	61.43%	62.34%	63.19%	64.01%	64.78%	65.52%	66.23%	66.90%	67.54%	68.15%	68.74%
1.75	43.49%	45.88%	48.03%	49.97%	51.74%	53.36%	54.85%	56.23%	57.51%	58.70%	59.81%	60.86%	61.84%	62.77%	63.64%	64.47%	65.26%	66.00%	66.71%	67.39%	68.04%	68.65%	69.24%	69.81%
1.80	45.36%	47.70%	49.79%	51.68%	53.40%	54.98%	56.42%	57.76%	59.00%	60.15%	61.23%	62.24%	63.19%	64.08%	64.93%	65.72%	66.48%	67.20%	67.88%	68.53%	69.15%	69.75%	70.31%	70.86%
1.85	47.19%	49.48%	51.52%	53.37%	55.04%	56.56%	57.97%	59.26%	60.46%	61.57%	62.61%	63.59%	64.50%	65.36%	66.18%	66.95%	67.67%	68.37%	69.02%	69.65%	70.25%	70.82%	71.36%	71.88%
1.90	48.99%	51.23%	53.22%	55.01%	56.64%	58.12%	59.47%	60.73%	61.88%	62.96%	63.97%	64.91%	65.79%	66.62%	67.40%	68.14%	68.84%	69.51%	70.14%	70.74%	71.32%	71.86%	72.39%	72.89%
1.95	50.76%	52.95%	54.89%	56.63%	58.20%	59.63%	60.95%	62.16%	63.28%	64.32%	65.29%	66.19%	67.04%	67.84%	68.60%	69.31%	69.98%	70.62%	71.23%	71.81%	72.36%	72.89%	73.39%	73.87%
2.00	52.50%	54.63%	56.51%	58.20%	59.73%	61.12%	62.39%	63.56%	64.64%	65.64%	66.58%	67.45%	68.27%	69.04%	69.76%	70.45%	71.10%	71.71%	72.30%	72.85%	73.38%	73.89%	74.37%	74.83%

Call Prices with Black & Scholes Option Pricing

Price of a B&Sch call option where result=C/S

Cumulative Volatility:	Moneyness: S/K*exp(-rT)																							
Sigma*SQRT(T)	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.55	2.60	2.65	2.70	2.75
0.00	37.50%	39.39%	41.18%	42.86%	44.44%	45.95%	47.37%	48.72%	50.00%	51.22%	52.38%	53.49%	54.55%	55.56%	56.52%	57.45%	58.33%	59.18%	60.00%	60.78%	61.54%	62.26%	62.96%	63.64%
0.05	37.50%	39.39%	41.18%	42.86%	44.44%	45.95%	47.37%	48.72%	50.00%	51.22%	52.38%	53.49%	54.55%	55.56%	56.52%	57.45%	58.33%	59.18%	60.00%	60.78%	61.54%	62.26%	62.96%	63.64%
0.10	37.50%	39.39%	41.18%	42.86%	44.44%	45.95%	47.37%	48.72%	50.00%	51.22%	52.38%	53.49%	54.55%	55.56%	56.52%	57.45%	58.33%	59.18%	60.00%	60.78%	61.54%	62.26%	62.96%	63.64%
0.15	37.50%	39.40%	41.18%	42.86%	44.44%	45.95%	47.37%	48.72%	50.00%	51.22%	52.38%	53.49%	54.55%	55.56%	56.52%	57.45%	58.33%	59.18%	60.00%	60.78%	61.54%	62.26%	62.96%	63.64%
0.20	37.55%	39.42%	41.20%	42.87%	44.45%	45.95%	47.37%	48.72%	50.00%	51.22%	52.38%	53.49%	54.55%	55.56%	56.52%	57.45%	58.33%	59.18%	60.00%	60.78%	61.54%	62.26%	62.96%	63.64%
0.25	37.73%	39.56%	41.29%	42.94%	44.50%	45.99%	47.40%	48.74%	50.01%	51.23%	52.39%	53.49%	54.55%	55.56%	56.52%	57.45%	58.33%	59.18%	60.00%	60.78%	61.54%	62.26%	62.96%	63.64%
0.30	38.09%	39.85%	41.53%	43.13%	44.65%	46.11%	47.49%	48.81%	50.07%	51.28%	52.43%	53.52%	54.57%	55.58%	56.54%	57.46%	58.34%	59.19%	60.01%	60.79%	61.54%	62.27%	62.97%	63.64%
0.35	38.64%	40.32%	41.93%	43.47%	44.94%	46.35%	47.70%	48.99%	50.22%	51.40%	52.53%	53.61%	54.64%	55.64%	56.59%	57.50%	58.38%	59.22%	60.03%	60.81%	61.56%	62.28%	62.98%	63.65%
0.40	39.34%	40.94%	42.48%	43.95%	45.37%	46.72%	48.03%	49.27%	50.47%	51.62%	52.72%	53.77%	54.79%	55.76%	56.70%	57.60%	58.46%	59.29%	60.09%	60.86%	61.61%	62.32%	63.01%	63.68%
0.45	40.18%	41.70%	43.16%	44.57%	45.93%	47.23%	48.48%	49.68%	50.83%	51.94%	53.01%	54.04%	55.02%	55.97%	56.89%	57.77%	58.61%	59.43%	60.21%	60.97%	61.70%	62.41%	63.09%	63.75%
0.50	41.12%	42.56%	43.96%	45.30%	46.60%	47.84%	49.04%	50.20%	51.31%	52.38%	53.41%	54.40%	55.35%	56.27%	57.16%	58.02%	58.84%	59.64%	60.41%	61.15%	61.86%	62.56%	63.22%	63.87%
0.55	42.14%	43.52%	44.85%	46.13%	47.36%	48.55%	49.70%	50.81%	51.88%	52.90%	53.90%	54.85%	55.77%	56.66%	57.52%	58.35%	59.15%	59.92%	60.67%	61.39%	62.09%	62.77%	63.42%	64.05%
0.60	43.22%	44.53%	45.80%	47.03%	48.21%	49.35%	50.45%	51.51%	52.53%	53.52%	54.47%	55.39%	56.28%	57.14%	57.96%	58.76%	59.54%	60.29%	61.01%	61.71%	62.39%	63.05%	63.68%	64.30%
0.65	44.35%	45.61%	46.82%	47.99%	49.12%	50.21%	51.26%	52.28%	53.26%	54.20%	55.12%	56.00%	56.86%	57.68%	58.48%	59.25%	60.00%	60.72%	61.42%	62.10%	62.76%	63.39%	64.01%	64.61%
0.70	45.52%	46.72%	47.88%	49.00%	50.08%	51.12%	52.13%	53.10%	54.04%	54.95%	55.83%	56.68%	57.50%	58.29%	59.06%	59.80%	60.52%	61.22%	61.90%	62.55%	63.18%	63.80%	64.40%	64.98%
0.75	46.72%	47.87%	48.98%	50.05%	51.08%	52.08%	53.04%	53.98%	54.88%	55.75%	56.59%	57.41%	58.19%	58.96%	59.70%	60.41%	61.10%	61.78%	62.43%	63.06%	63.67%	64.26%	64.84%	65.40%
0.80	47.93%	49.03%	50.10%	51.12%	52.12%	53.07%	54.00%	54.89%	55.75%	56.59%	57.40%	58.18%	58.94%	59.67%	60.38%	61.07%	61.73%	62.38%	63.01%	63.62%	64.21%	64.78%	65.34%	65.88%
0.85	49.16%	50.22%	51.24%	52.22%	53.17%	54.09%	54.98%	55.84%	56.66%	57.47%	58.24%	58.99%	59.72%	60.42%	61.11%	61.77%	62.41%	63.03%	63.63%	64.22%	64.79%	65.34%	65.88%	66.40%
0.90	50.40%	51.42%	52.40%	53.34%	54.25%	55.13%	55.98%	56.81%	57.60%	58.37%	59.11%	59.84%	60.53%	61.21%	61.86%	62.50%	63.12%	63.71%	64.30%	64.86%	65.41%	65.94%	66.46%	66.96%
0.95	51.65%	52.62%	53.56%	54.47%	55.34%	56.19%	57.01%	57.79%	58.56%	59.30%	60.01%	60.70%	61.37%	62.02%	62.65%	63.26%	63.86%	64.43%	64.99%	65.53%	66.06%	66.57%	67.07%	67.55%
1.00	52.90%	53.83%	54.73%	55.60%	56.44%	57.26%	58.04%	58.80%	59.53%	60.24%	60.93%	61.59%	62.23%	62.86%	63.46%	64.05%	64.62%	65.17%	65.71%	66.23%	66.74%	67.23%	67.71%	68.18%
1.05	54.14%	55.04%	55.91%	56.74%	57.55%	58.33%	59.08%	59.81%	60.51%	61.20%	61.85%	62.49%	63.11%	63.71%	64.29%	64.86%	65.40%	65.93%	66.45%	66.95%	67.44%	67.91%	68.38%	68.82%
1.10	55.38%	56.25%	57.08%	57.88%	58.66%	59.41%	60.13%	60.83%	61.51%	62.16%	62.79%	63.41%	64.00%	64.58%	65.14%	65.68%	66.20%	66.71%	67.21%	67.69%	68.16%	68.62%	69.06%	69.49%
1.15	56.61%	57.45%	58.25%	59.02%	59.77%	60.49%	61.18%	61.85%	62.50%	63.13%	63.74%	64.33%	64.90%	65.45%	65.99%	66.51%	67.02%	67.51%	67.98%	68.45%	68.90%	69.34%	69.76%	70.18%
1.20	57.84%	58.64%	59.41%	60.15%	60.87%	61.56%	62.23%	62.87%	63.50%	64.10%	64.69%	65.25%	65.80%	66.33%	66.85%	67.35%	67.84%	68.31%	68.77%	69.21%	69.65%	70.07%	70.48%	70.88%
1.25	59.05%	59.82%	60.56%	61.28%	61.97%	62.63%	63.27%	63.90%	64.50%	65.08%	65.64%	66.18%	66.71%	67.22%	67.71%	68.20%	68.66%	69.12%	69.56%	69.99%	70.40%	70.81%	71.20%	71.59%
1.30	60.26%	61.00%	61.71%	62.40%	63.06%	63.70%	64.32%	64.91%	65.49%	66.05%	66.59%	67.11%	67.61%	68.11%	68.58%	69.04%	69.49%	69.93%	70.35%	70.76%	71.16%	71.55%	71.93%	72.30%
1.35	61.44%	62.16%	62.84%	63.50%	64.14%	64.76%	65.35%	65.92%	66.48%	67.01%	67.53%	68.03%	68.52%	68.99%	69.45%	69.89%	70.32%	70.74%	71.15%	71.54%	71.93%	72.30%	72.67%	73.02%
1.40	62.62%	63.30%	63.96%	64.60%	65.21%	65.80%	66.37%	66.92%	67.46%	67.97%	68.47%	68.95%	69.42%	69.87%	70.31%	70.74%	71.15%	71.56%	71.95%	72.33%	72.70%	73.06%	73.41%	73.75%
1.45	63.78%	64.44%	65.07%	65.68%	66.27%	66.84%	67.39%	67.92%	68.43%	68.92%	69.40%	69.87%	70.32%	70.75%	71.17%	71.58%	71.98%	72.37%	72.74%	73.11%	73.46%	73.81%	74.15%	74.47%
1.50	64.92%	65.55%	66.16%	66.75%	67.32%	67.86%	68.39%	68.90%	69.39%	69.87%	70.33%	70.77%	71.20%	71.62%	72.03%	72.42%	72.80%	73.17%	73.54%	73.89%	74.23%	74.56%	74.88%	75.20%
1.55	66.04%	66.65%	67.24%	67.81%	68.35%	68.87%	69.38%	69.87%	70.34%	70.80%	71.24%	71.67%	72.08%	72.48%	72.87%	73.25%	73.62%	73.98%	74.32%	74.66%	74.99%	75.31%	75.62%	75.92%
1.60	67.15%	67.74%	68.30%	68.84%	69.37%	69.87%	70.36%	70.83%	71.28%	71.72%	72.14%	72.55%	72.95%	73.34%	73.71%	74.08%	74.43%	74.77%	75.10%	75.43%	75.74%	76.05%	76.35%	76.64%
1.65	68.24%	68.80%	69.34%	69.87%	70.37%	70.85%	71.32%	71.77%	72.21%	72.63%	73.04%	73.43%	73.81%	74.18%	74.54%	74.89%	75.23%	75.56%	75.88%	76.19%	76.49%	76.78%	77.07%	77.35%
1.70	69.31%	69.85%	70.37%	70.87%	71.35%	71.82%	72.27%	72.70%	73.12%	73.52%	73.91%	74.29%	74.66%	75.02%	75.36%	75.70%	76.02%	76.34%	76.64%	76.94%	77.23%	77.51%	77.79%	78.05%
1.75	70.35%	70.87%	71.37%	71.86%	72.32%	72.77%	73.20%	73.61%	74.02%	74.40%	74.78%	75.14%	75.50%	75.84%	76.17%	76.49%	76.80%	77.10%	77.40%	77.68%	77.96%	78.23%	78.50%	78.75%
1.80	71.38%	71.88%	72.36%	72.82%	73.27%	73.70%	74.11%	74.51%	74.90%	75.27%	75.63%	75.98%	76.32%	76.64%	76.96%	77.27%	77.57%	77.86%	78.14%	78.42%	78.68%	78.94%	79.20%	79.44%
1.85	72.39%	72.87%	73.33%	73.77%	74.20%	74.61%	75.01%	75.39%	75.76%	76.12%	76.47%	76.80%	77.12%	77.44%	77.74%	78.04%	78.33%	78.60%	78.88%	79.14%	79.40%	79.64%	79.89%	80.12%
1.90	73.37%	73.83%	74.28%	74.70%	75.11%	75.51%	75.89%	76.26%	76.61%	76.95%	77.29%	77.61%	77.92%	78.22%	78.51%	78.80%	79.07%	79.34%	79.60%	79.85%	80.10%	80.33%	80.57%	80.79%
1.95	74.33%	74.78%	75.20%	75.61%	76.00%	76.38%	76.75%	77.10%	77.44%	77.77%	78.09%	78.40%	78.70%	78.99%	79.27%	79.54%	79.80%	80.06%	80.31%	80.55%	80.78%	81.01%	81.24%	81.45%
2.00	75.27%	75.70%	76.11%	76.50%	76.88%	77.24%	77.59%	77.93%	78.26%	78.57%	78.88%	79.17%	79.46%	79.74%	80.00%	80.26%	80.52%	80.76%	81.00%	81.23%	81.46%	81.68%	81.89%	82.10%